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NoFoam Unit Installation, Evaluation and Operations Manual

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Naval Facilities Engineering Service Center requested the Air Force Research Laboratory (AFRL) Fire Research Group to conduct an independent installation and evaluation of the Universal Stationary/Mobile NoFoam Unit using AFRL vehicles and facilities. Currently, the majority of Fire Departments that use 3% Aqueous Film Forming Foam (AFFF) liquid concentrate in their fleet do not have the facilities available to conduct annual foam proportioning testing of their vehicles (National Fire Protection Association 1911 Section 3.1). The purpose of the NoFoam Unit is to replace the 3% AFFF liquid concentrate with an environmentally benign agent (water or dye-water) during foam operational testing. This project evaluated the operational performance of the NoFoam Unit on two independent P-19 ARFF vehicles. Twenty-seven tests were completed with Vehicle 1 and thirteen tests with Vehicle 2. The NoFoam Unit operated as designed during all testing and identified several mechanical problems with the handline and turret systems on the P-19s. The NoFoam Unit was easily adapted to the P-19, provided a reliable alternative to conducting standard testing of foam proportioning systems and assisted in troubleshooting mechanical problems with the handline/turret systems. This report contains information on the installation, evaluations and operational manual for the NoFoam Unit.

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ABSTRACT

Naval Facilities Engineering Service Center requested the Air Force Research Laboratory (AFRL) Fire Research Group to conduct an independent installation and evaluation of the Universal Stationary/Mobile NoFoam Unit using AFRL vehicles and facilities. Currently, the majority of Fire Departments that use 3% Aqueous Film Forming Foam (AFFF) liquid concentrate in their fleet do not have the facilities available to conduct annual foam proportioning testing of their vehicles (National Fire Protection Association 1911 Section 3.1). The purpose of the NoFoam Unit is to replace the 3% AFFF liquid concentrate with an environmentally benign agent (water or dye-water) during foam operational testing. This project evaluated the operational performance of the NoFoam Unit on two independent P-19 ARFF vehicles. Twenty-seven tests were completed with Vehicle 1 and thirteen tests with Vehicle 2. The NoFoam Unit operated as designed during all testing and identified several mechanical problems with the handline and turret systems on the P-19s. The NoFoam Unit was easily adapted to the P-19, provided a reliable alternative to conducting standard testing of foam proportioning systems and assisted in troubleshooting mechanical problems with the handline/turret systems. This report contains information on the installation, evaluations and operational manual for the NoFoam Unit.

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INTRODUCTION

Naval Facilities Engineering Service Center requested the Air Force Research Laboratory (AFRL) Fire Research Group to conduct an independent installation and evaluation of the Universal Stationary/Mobile NoFoam Unit. AFRL has several Aircraft Rescue and Fire Fighting (ARFF) vehicles for research purposes and possesses unique facilities to perform multiple installations and evaluations over an extended period.

BACKGROUND

Currently the majority of Fire Departments that have ARFF vehicles that use 3% Aqueous Film Forming Foam (AFFF) liquid concentrate in their fleet do not have the facilities available to conduct foam proportioning testing of their vehicles. In accordance with National Fire Protection Association (NFPA) 1911 Section 3.1, a service test shall be conducted at least annually, and whenever major repairs or modifications to the pump or any components of the apparatus that is used in pump operations have been made. The purpose of the NoFoam Unit is to replace the 3% AFFF liquid concentrate with an alternative agent (water or dye-water) during foam fire fighting operational testing. With the use of this alterative agent, Fire Departments will be able to conduct complete operational checks of their ARFF vehicles foam fire fighting system without contaminating the environment with the by produces of AFFF. The NoFoam Unit is fully self-contained on its own trailer allowing Fire Departments to conduct ARFF vehicle foam system testing at the station or tow the NoFoam Unit to a location within close proximity.

This project evaluated the operational performance of the NoFoam Unit for the P-19 ARFF Vehicle. Testing started in April 2001 and was completed February 2002. The NoFoam Unit Retrofit Module was installed on two vehicles for testing, Vehicle 1 (84L1229) a standard P-19 and Vehicle 2 (85L1096) a modified P-19. The bumper turret and handline on Vehicle 2 were modified with a Compressed Air Foam System (CAFS). Twenty-five tests were completed with Vehicle 1 and thirteen tests with Vehicle 2.

DATA ACQUISITION

The NoFoam Unit digital flow monitor measured in gallons per minute (gpm) the amount of alternative agent used during roof turret, bumper turret and handline testing. Digital flow monitor value, water pump pressure gauge value, discharge times and comments/problems were annotated on data sheets provided by the Naval Facilities Engineering Service Center. Data collected for each test cycle is shown in Appendix A.

PROCEDURES

1. After receiving the NoFoam Unit, the retrofit module was installed on test vehicles. The installation took one man between 30-45 minutes to complete per vehicle.

2. The foam tank was isolated by closing the 2" gate valve, and the residual AFFF was drained from the foam system. The drained AFFF was poured back into the foam tank.

3. After connecting the NoFoam Unit to the vehicle, the foam tank drain valve was opened until a steady stream of alternative agent flows freely, then the valve was closed.

4. With the vehicle started and the agent selector switch placed in the foam position a testing cycle was started. Each testing cycle consisted of discharging agent from the roof turret, then the bumper turret, then the handline and a combination of the roof turret and bumper turret.

5. Discharge times were predetermined prior to each testing cycle. Various times were used ranging from 10 to 30 seconds.

6. Discharge times, digital flow monitor value and pump pressure gauge value were annotated on data sheets along with any comments or problems.

7. Upon completion of the testing cycle, the alternative agent was drained from the foam system and the 2" gate valve (AFFF foam tank isolation valve) was reopened.

Note: see Appendix B for complete systematic procedures on conducting NoFoam Unit testing on the P-19 ARFF vehicle.

EVALUATION - TEST VEHICLE 1

After the installation of the NoFoam Unit retrofit module on Vehicle 1, one testing cycle was completed. The testing cycle was invalid because the proportioning plate inside the multi-metering manifold was not installed properly. Two additional mechanical problems were identified including a faulty roof turret cylinder valve that was stuck in the ON position and a faulty bumper turret cylinder valve that was stuck in the OFF position. After properly installing the proportioning plate in the multi-metering manifold and replacing the roof and bumper turret cylinder valves, three cycles were conducted to establish a base line.

Cycles 1 through 2: Readings were not recorded during the handline operation due to a small leak coming from the handline cylinder valve. The leak in the handline cylinder valve was repaired prior to the next testing cycle.

Cycle 3: Testing was conducted and all readings were annotated on the data sheet.

Cycles 4 through 7: Readings were not recorded during the handline operation. The handline cylinder valve was replaced.

Cycles 8 through 14: Testing was completed and all readings were annotated on data sheets.

Cycle 15: Testing showed no reading during the handline operation and a trace of foam was noticed coming out of the roof and bumper turret while discharging. After an inspection of the system, technicians identified a problem in the handline relay switch, which failed to operate as designed and the foam tank valve was leaking in the closed position. The vehicle was turned into maintenance and the handline relay switch and foam tank valve were replaced.

Cycles 16 through 27: Testing was completed and all readings were annotated on data sheets

EVALUATION - TEST VEHICLE 2

Cycles 1 through 7: Testing was conducted with Vehicle 2 in the CAFS mode. During each test, the handline readings were consistently high. After a complete diagnostics check of the CAFS system, technicians discovered that when the CAFS switch was turned ON the bumper cylinder valve would automatically open. This increased the amount of alternative agent being inducted during the handline operation.

Cycles 8 through 13: Testing was completed with the CAFS switch in the OFF position and the handline readings dropped within the established parameters of the testing.

RESULTS

After completing four testing cycles with Vehicle 1 and Vehicle 2, debris began to appear in the collection containers while draining the AFFF from the foam system. This continued during the next 3 to 4 testing cycles. All testing cycles afterwards showed no traces of debris.

Vehicle 1 identified the following problems:

1. Proportioning plate inside the multi-metering manifold was not properly installed.
2. Faulty roof, bumper, and handline cylinder valves.
3. Faulty handline relay switch.
4. Worn foam tank 2” gate valve (failed to close completely).

Vehicle 2 identified the following problems:

1. High pump pressure value readings (pump pressure relief valve was out of adjustment).

2. Foam fill check valve failed to seal properly (caused by debris in foam system).

PERFORMANCE OF THE NOFOAM UNIT

The NoFoam Unit operated as designed during all testing. The NoFoam Unit was towed on several occasions to various locations at speeds up to 10 miles per hour without any difficulties. All piping and valves operated properly with no leaks or signs of wear. The solar powered battery charging system maintained a full charge for the digital flow monitor battery throughout the testing period. The NoFoam Unit was stationed outside during the entire duration of testing. The alternative agent (water with dye) was drained from the system anytime the temperature dropped below 32 °F (Because the NoFoam Unit does not use antifreeze in the alternate agent mixture, the unit cannot be operated at temperatures below freezing).

RECOMMENDATIONS

1. Recommend the NoFoam trailer have reflective tape on all four corners of the trailer and some just behind the pintle hook to make it more visible after dark.

2. A trailer light kit should be offered as an optional item for the NoFoam Unit.

3. Install baffles inside the 400-gallon water tank to help minimize sloshing, which may cause rollover during towing.

4. Additional testing of the NoFoam Trailer should be accomplished to determine the maximum safe towing speed of the unit with the results annotated on a warning label and attached to the unit.

5. The NoFoam Unit comes complete with four 5-gallon collection containers. Recommend that one of the containers be replaced with a smaller sized container so that it can be placed under the vehicle to collect the AFFF from the foam drain line.

6. Recommend that the initial testing cycles be conducted once a week for the first two months then once a month afterwards.

7. The NoFoam Unit works well as a means of performing a complete operational check of the ARFF vehicle foam fire fighting systems. In addition, this unit can also be used as a valuable tool for Fire Department Mechanics in troubleshooting malfunctions in the foam fire fighting system.

8. The NoFoam Unit (filled with AFFF) may be able to be used as a foam trailer for a rapid resupply to ARFF vehicles during prolonged fire fighting operations. However, additional testing should be completed in this area.

CONCLUSIONS

The NoFoam Unit provided a reliable alternative to conducting annual testing of foam proportioning systems on the P-19 ARFF vehicle. Modifications to the P-19 to accommodate the system and testing with the unit were easily accomplished with two people. In addition, the NoFoam Unit was also useful as a maintenance and troubleshooting tool for the turret and handline systems on the P-19.

APPENDIX A: NoFoam Unit Test Data

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 01

date: 27 April 2001 AFFF: 3% plate

by: jennifer / bill / al / rkudo

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper			28	10	
			28	20	
			28	15	*water press = 320 psi
Roof			19	5	
			19	10	
			19	10	*water press = 345 psi
Bumper			9.9 - 10	10	
			9.9 - 10	15	
			9.8	10	*water press = 345 psi
Handline			1.6	10	
			1.7	10	
			1.5 - 1.6	15	*water press = 345 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 02

date: 2 May 2001 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper			28	15	*water press = 340 psi
Roof			18	15	*water press = 340 psi
Bumper			9.7	15	*water press = 340 psi
Handline			0	15	Noticed a leak on the handline proportioning valve inside compartment.
			0	15	May have been the cause of getting a "0" reading. Will repair prior to next
			0	15	
			0	60	*water press = 320 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 03

date: 4 May 2001 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper			28	15	*water press = 320 psi
Roof			19	15	*water press = 340 psi
Bumper			10	15	*water press = 340/330 psi
Handline			0 0	15 25	Still leaking from proportioning valve *water press = 340 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 04

date: 5-14-01 AFFF: 3% plate

by: WHF

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					1. Foam was used on 5-9-01 2. Pump pressure gauge was replaced water press = ___ psi
Roof + Bumper	750	10	28	15	*water press = 270 psi
Roof	500	10	20	10	*water press = 270 psi
Bumper	250	10	10	15	*water press = 240 psi
Handline	95	10	0.8	15	*water press = 240 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 05

date: 5-18-01 AFFF: 3% plate

by: WHF

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper	750	15	29	15	*water press = 280 psi
Roof	500	15	19	15	*water press = 300 psi
Bumper	250	15	9.9/10	15	*water press = 290 psi
Handline	95	15	0 0	15 15	*water press = 310/240 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 06

date: 5-25-01 AFFF: 3% plate

by: WHF

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper	750	10	28	10	*water press = 160 psi
Roof	500	10	19	10	*water press = 200 psi
Bumper	250	10	10	10	*water press = 220-230 psi
Handline	95	10	0 0	10 10	unable to get reading *water press = 290 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 07

date: 6-01-01 AFFF: 3% plate

by: WHF

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper	750	15	28	10	*water press = 270 psi
Roof	500	15	19	10	*water press = 290 psi
Bumper	250	15	9.9/10	10	*water press = 290 psi
Handline	95	15	0 0	10 15	*water press = 300 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 08

date: 6-4-01 AFFF: 3% plate

by: WHF/HS

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper	750	10	28	15	*water press = 180-190 psi
Roof	500	10	20	15	*water press = 210-220 psi
Bumper	250	10	10	15	*water press = 230-240 psi
Handline	95	10	0	15	dye showing but no reading *water press = 280 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 09

date: 6-4-01 AFFF: 3% plate

by: WHF/HS

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = ___ psi
Roof + Bumper	750	10	20	10	*water press = 160-170 psi
Roof	500	10	18	10	*water press = 230-240 psi
Bumper	250	11	10	10	*water press = 230 psi
Handline	95	11	1.6	10	Repaired handline proprtional valve. Valve was not opening to the full position. *water press = 290 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 10

date: 6/05/01 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					
Roof + Bumper	750	10	27	10	water press = 250 psi
Roof	500	10	18	10	*water press = 280 psi
Bumper	250	10	9.8 9.9	10 10	*water press = 270/280 psi
Handline	95	10	1.5	10	*water press = 280 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 11

date: 6/15/01 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = 210 psi
Roof + Bumper			28	10	*water press = 300 psi
Roof			18	10	*water press = 295 psi
Bumper			9.9	10	*water press = 285 psi
Handline			1.6	10	Noticed a leak on the handline proportioning valve inside compartment. May have been the cause of getting a "0" reading. Will repair prior to next *water press = 320 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 12

date: 6/15/01 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					
Roof + Bumper			28	10	water press = 210 psi
Roof			18	10	*water press = 300 psi
Bumper			9.9	10	*water press = 295 psi
Handline			1.6	10	*water press = 285 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 13

date: 6/15/01 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					
Roof + Bumper			28	10	water press = 210 psi
Roof			18	10	*water press = 300 psi
Bumper			10	10	*water press = 290 psi
Handline			1.8	10	*water press = 285 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 14

date: 6/22/01 AFFF: 3% plate

by: bill

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					
Roof + Bumper			28	10	water press = 280 psi
Roof			20	10	*water press = 320 psi
Bumper			10 9.9	10 10	*water press = 340 psi
Handline			1.8	10	*water press = 330 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 15

date: 7/18/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	15	*water press = 120 psi
Roof			19	15	*water press = 240 psi
Bumper			10	15	*water press = 185 psi
Handline			1.7	15	*water press = 220 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 16

date: 7/19/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	15	*water press = 120 psi
Roof			19	15	*water press = 150 psi
Bumper			10	15	*water press = 180 psi
Handline			1.8	15	*water press = 200 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L-1229 (Det Vehicle) sheet no.: 17

date: 8/03/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			27	10	*water press = 230 psi
Roof			20	10	*water press = 250 psi
Bumper			9.6	10	*water press = 240 psi
Handline					handline relay switch inoperable, no test results *water press = 200 psi

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 18

date: 8/10/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			23	15	*water press = 30 psi/1400rpm
Roof			19	15	*water press = 325 psi
Bumper			9.2	15	*water press = 50 psi/1600 rpm
Handline			10	15	*water press = 150 psi/1400 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 19

date: 8/10/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	10	*water press = 40 psi/1400rpm
Roof			19	10	*water press = 325 psi
Bumper			9.1	10	*water press = 50 psi/1400 rpm
Handline			10	10	*water press = 160 psi/1500 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 20

date: 9/13/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			31	20	*water press = 80 psi/1400rpm
Roof			17	20	*water press = 340 psi/2200 rpm
Bumper			9.3	20	*water press = 95-100 psi/1400 rpm
Handline			11	20	*water press = 180 psi/1600 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 21

date: 9/13/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	20	*water press = 60 psi/1150rpm
Roof			18	20	*water press = 340 psi/2200 rpm
Bumper			9	20	*water press = 75 psi/1300 rpm
Handline			10	20	*water press = 180 psi/1600 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 22

date: 9/21/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	15	*water press = 95-100 psi/1500rpm
Roof			17	15	*water press = 326 psi/2200 rpm
Bumper			9.1	15	*water press = 100 psi/1500 rpm
Handline			10	15	*water press = 140 psi/1400 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 23

date: 9/14/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	15	*water press = 95-100 psi/1500rpm
Roof			18	15	*water press = 326 psi/2200 rpm
Bumper			8.9	15	*water press = 100 psi/1500 rpm
Handline			10	15	*water press = 140 psi/1400 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1096 (CAFS) sheet no.: 24

date: 9/14/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	15	*water press = 95-100 psi/1500rpm
Roof			18	15	*water press = 320 psi/2200 rpm
Bumper			8.9	15	*water press = 100 psi/1500 rpm
Handline			10	15	*water press = 140 psi/1400 rpm

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85B1229 sheet no.: 25

date: 10/26/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			29	10	*water press = 180
Roof			19	10	*water press = 170
Bumper			9.9	10	*water press = 190
Handline			2	10	*water press = 180

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85B1229 sheet no.: 26

date: 10/29/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			29	10	*water press = 150
Roof			21	10	*water press = 150
Bumper			9.4	10	*water press = 200
Handline			2.1	10	*water press = 180

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1229 sheet no.: 27

date: 11/02/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			29	15	*water press = 210
Roof			19	15	*water press = 240
Bumper			10	15	*water press = 200
Handline			1.8/1.9	15	*water press = 230

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 85L1229 sheet no.: 28

date: 11/02/01 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			29	15	*water press = 220
Roof			19	15	*water press = 240
Bumper			10	15	*water press = 240
Handline			1.9	15	*water press = 230

NOTE: Blank = NO DATA

***Water pump pressure gage is inoperable.**

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 29

date: 02/11/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	10	*water press = 280
Roof			18	10	*water press = 325
Bumper			10	10	*water press = 325
Handline			2.1	10	*water press = 325

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 30

date: 02/11/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			27	15	*water press = 290
Roof			18	15	*water press = 325
Bumper			10	15	*water press = 325
Handline			2.1	15	*water press = 325

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 31

date: 02/12/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	20	*water press = 290
Roof			18	20	*water press = 325
Bumper			9.5	20	*water press = 325
Handline			1.7	20	*water press = 325

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 32

date: 02/12/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	20	*water press = 290
Roof			18	20	*water press = 325
Bumper			9.6	20	*water press = 325
Handline			1.7	20	*water press = 325

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 33

date: 02/13/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			28	20	*water press = 130
Roof			18	20	*water press = 240
Bumper			9.7	20	*water press = 180
Handline			1.8	20	*water press = 230

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 84L1229 sheet no.: 34

date: 02/13/02 AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			27	20	*water press = 230
Roof			19	20	*water press = 230
Bumper			9.7	20	*water press = 230
Handline			1.8	20	*water press = 230

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 35

date: 02/26/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			25	20	*water press = 150
Roof			18	20	*water press = 225
Bumper			8.8	20	*water press = 150
Handline			1.9	20	*water press = 225

NOTE: Blank = NO DATA

Testing was completed with CAFS turned off

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 36

date: 02/26/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	30	*water press = 150
Roof			18	30	*water press = 225
Bumper			9	30	*water press = 150
Handline			1.8	30	*water press = 225

NOTE: Blank = NO DATA

Testing was completed with CAFS turned off

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 37

date: 02/27/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	20	*water press = 150
Roof			17	20	*water press = 225
Bumper			9.4	20	*water press = 150
Handline			1.8 No CAFS 10 w/CAFS	20	*water press = 225

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 38

date: 02/27/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			26	20	*water press = 150
Roof			17	20	*water press = 225
Bumper			9.5	20	*water press = 150
Handline			2	20	*water press = 225

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 39

date: 02/28/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			25	15	*water press = 140
Roof			17	15	*water press = 225
Bumper			9	15	*water press = 150
Handline			1.8	15	*water press = 250

NOTE: Blank = NO DATA

P19

TRUCK SERIAL NO.: 85L1096 CAFS

sheet no.: 40

date: 02/28/02

AFFF: 3% plate

by: bill/al

DISCHARGE TABLE

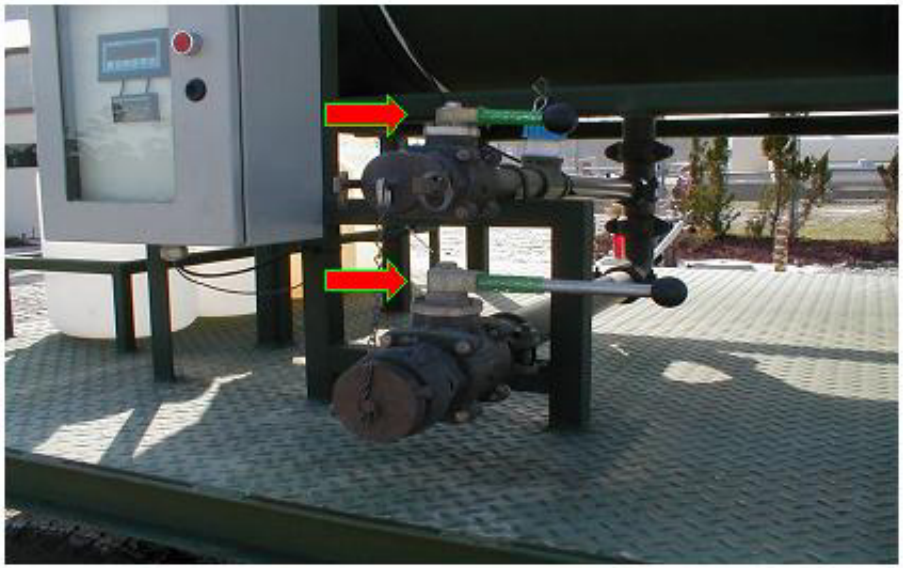
STATION	WATER DISCHARGE FLOW RATE (GPM)	WATER DISCHARGE TIME (SEC)	DYE-WATER DISCHARGE FLOW RATE (GPM)	DYE-WATER DISCHARGE TIME (SEC)	COMMENTS / PROBLEMS
Roof + Bumper + Handline					water press = psi
Roof + Bumper			25	10	*water press = 200
Roof			16	10	*water press = 220
Bumper			9.2	10	*water press = 135
Handline			1.8	10	*water press = 225

NOTE: Blank = NO DATA

APPENDIX B: NoFoam Unit Operational Manual

NoFoam Unit Operations Manual

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
TRAILER



- **Close all ball valves, both 1-1/2” and 2” valves**

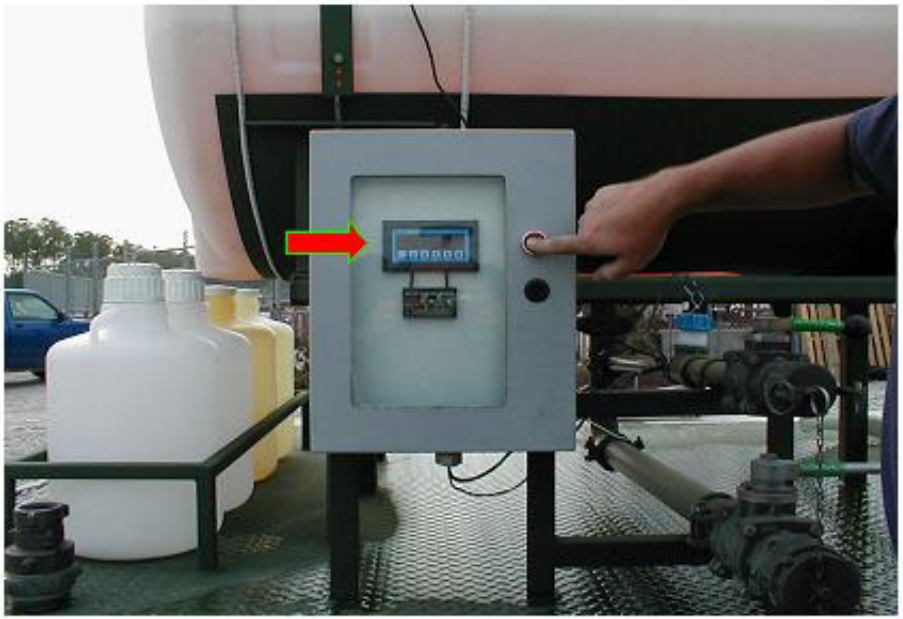
P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
TRAILER

- **Fill water tank**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
TRAILER

- **If required, add fluorescent yellow/green dye to water tank**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
TRAILER



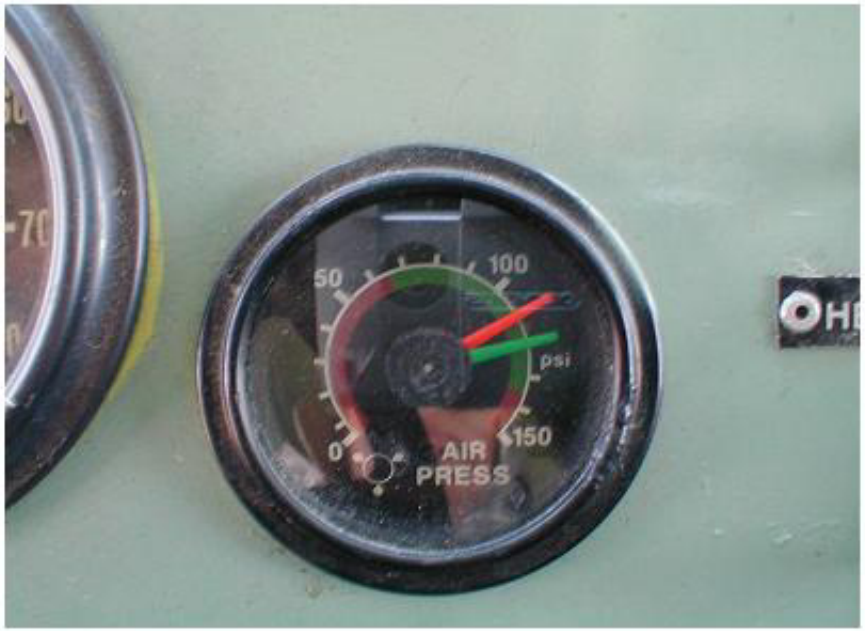
- **Turn on electrical panel (push button), ensure panel meter is on.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **P-19 ARFF Vehicle is "OFF"**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
USNOFU Set-up



- **Verify vehicle air tanks are at 120 psi capacity, existing gage from inside the cab.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **With the Master switch "ON". Set agent selector valve to the "FOAM" position, existing valve control from inside the cab.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
USNOFU Set-up

- **Close AFFF concentrate tank valve, 2” gate valve**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Drain residual AFFF from 2” ball valve using existing drain hose.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Remove cap from connection "A" and attach fitting "A", open 1-1/2" ball valve "A" and drain residual AFFF concentrate into 5-1/2 gallon polyethylene bottle. When completely drained, close ball valve "A" and remove fitting "A".**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Remove 1-1/2" cap from external AFFF fill connection and attach fitting "B", and drain residual AFFF concentrate into 5-1/2 gallon polyethylene bottle. When completely drained, remove fitting "B" and replace fill cap.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

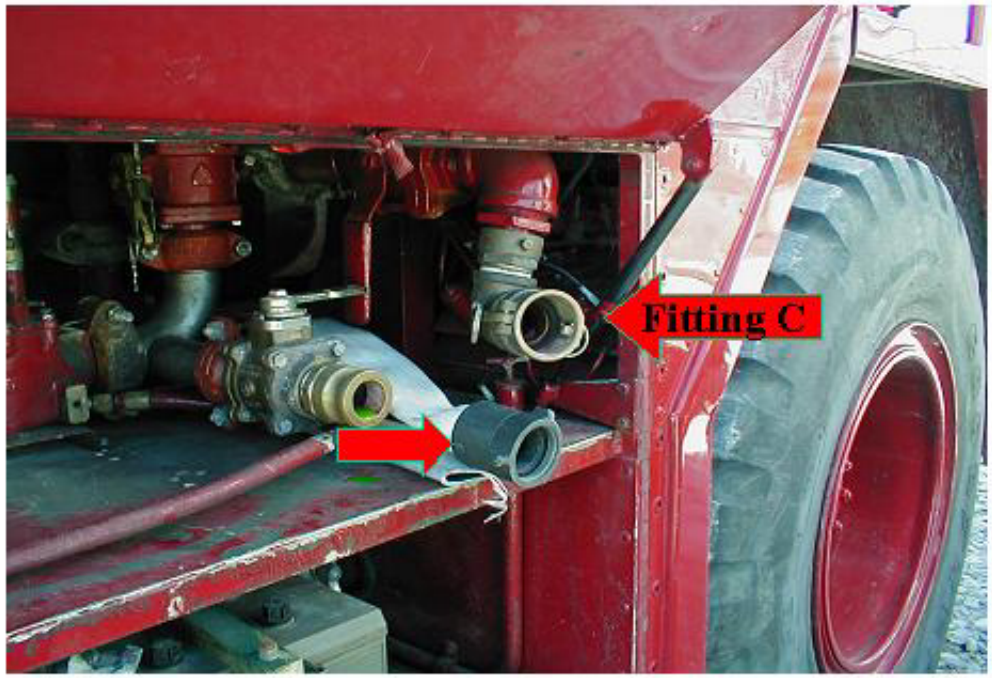
- **Open 3/8" AFFF drain valves and collect into 5-1/2 gallon polyethylene bottle. When completely drained, close valves.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Approximately 2-3/4 gallons of AFFF concentrate will be collected, recycle or dispose.**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
USNOFU Set-up



- **Remove hose from AFFF tank drain connection, attach fitting "C"**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE
USNOFU Set-up

- Attach fitting "D" to fitting "C"

Attach other end of fitting"D" to trailer connection "D" (1-1/2" ball valve). Open connection "D"

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Open AFFF tank drain valve "C"**

P-19 – NOFOAM UNIT OPERATIONAL PROCEDURE

USNOFU Set-up

- **Set agent selector valve to the "OFF" position (existing valve control)**
- **Ready to begin nozzle discharge testing**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Nozzle discharge test

- **Start Vehicle (P-19)**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Nozzle discharge test

- **Set agent selector valve to the "FOAM" position (existing valve control)**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Nozzle discharge test

- **Open station nozzle valve(s) – Roof, Bumper, Handline, or Combination**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Nozzle discharge test

- **Read and record: Digital flow monitor value, Water pump pressure gage value, elapsed time, and annotate problems/comments.**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Shut vehicle OFF and verify air tanks are at 120 psi capacity**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Set agent selector valve to the "FOAM" position**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- Close 2" ball valve "D"

Remove fitting "D" from fitting "C" and connection "D" from trailer

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Remove fitting "C" and re-connect hose**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Completely drain alternative agent from the foam system.**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- "IMPORTANT"
- OPEN AFFF TANK 2" GATE VALVE

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Open valve "A" and drain AFFF concentrate into 5-1/2 gallon bottle until a steady stream of AFFF concentrate is seen. Close valve and remove fitting "A".**

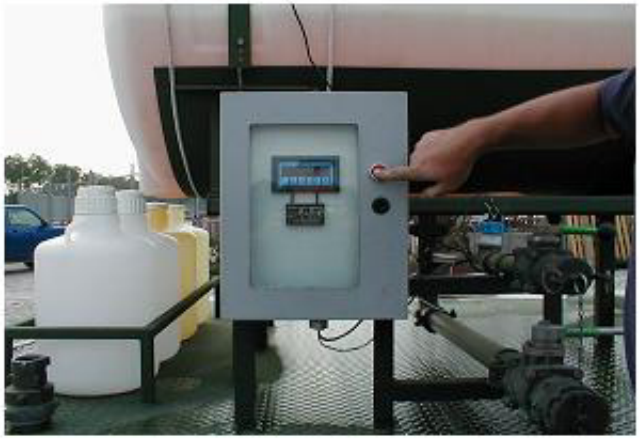
P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Recycle or dispose of AFFF concentrate.**

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit



- **Turn OFF electrical panel**

Set agent selector valve to OFF

P-19 NOFOAM UNIT OPERATIONAL PROCEDURE

Shut-down NoFoam Unit

- **Fill vehicle with water and or foam as needed**

Secure NoFoam Unit operations